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THE POLITICAL SCIENCE OF SCIENCE:

AN INQUIRY INTO THE POSSIBLE RECONCILIATION OF MASTERY AND FREEDOM*

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My intention is to consider political science as a discipline and as a profession in relation to the impact of the physical and biological sciences and of engineering upon the life of man. I propose to inquire into the possible reconciliation of man's mastery over Nature with freedom, the overriding goal of policy in our body politic.

In the interest of concreteness I shall have something to say about past and potential applications of science in three areas: armament, production, and evolution.

I. POLITICAL SCIENCE AND ARMAMENT

It is trite to acknowledge that for years we have lived in the afterglow of a mushroom cloud and in the midst of an arms race of unprecedented gravity. Here I shall support a proposition that may at first evoke some incredulous exclamations. The proposition is that our intellectual tools have been sufficiently sharp to enable political scientists to make a largely correct appraisal of the consequences of unconventional weapons for world politics.

We have correctly understood the strength of the factors that perpetuate a feeble international order even in the face of recent technoscientific developments. The traditional tools at our disposal for the analysis of politics prepare us to regard a voluntary relinquishment of power as much less likely than efforts to perpetuate power. In a divided world it is not surprising to find that more elites expect to be in a better position by continuing the current system than by taking the risks involved in consenting to a new structure of power. But we have not dis-

* Presidential address delivered at the annual meeting of the Association in Washington, D. C., September 6, 1956.

missed as altogether hopeless the prospects of a more perfect union, achieved by measures short of general war. On the occasions when power is relinquished those who make the seeming sacrifice actually expect to be better off eventually in terms of power (and other values) than if they fail to pay the price.

For at times voluntary confederation, federation or integration does take place. Steps toward unity occur when elites perceive an external threat or obstacle to the preservation or fuller realization of commonly interpreted values. It occurs when elites perceive a common internal threat or obstacle. When atomic weapons appeared on the scene it required no great acumen to see that they were introduced under circumstances in which factors of division were heavily loaded against factors favoring a new structure of unity. Nuclear weapons were introduced unilaterally by one member of a wartime coalition. It is noteworthy that the innovating member did not feel sufficiently bound to allied and associated powers to share the new weapons with the coalition. When the enemy was defeated incentives to share were reduced. They were further reduced by the estrangement that promptly set in to separate the partners in a coalition that had been unable to achieve a high level of trust and cooperation even under the provocation of war.

It was easy to recognize that the active political elite of the largest potential rival of the United States had more inducements to procrastinate than to make the immediate sacrifices that would have been necessary for a global system of security. Moscow leaders were not faced by an ultimatum, but by an inspection proposal that in the beginning would undoubtedly have laid bare the full depth of Soviet weakness and disunity. The immediate burden of sacrifice would have fallen upon one side; what was missing was a means of equalizing the cost throughout the whole course of the proposed arrangement. Moscow had no grounds for believing that the decision makers of the outside world viewed them or their ideology or their technique with such benevolence that any visible vulnerability would remain unexploited. Certainly the annihilation of mankind seemed remote and hypothetical when compared with the deprivations likely to follow at once the formation of a new international structure.

It was no necessary part of the analysis to assume that leading Soviet figures loved war (after the manner of Ghenghis Khan and other nomadic "shepherds of men"). We understood that it would be political suicide for individual leaders on either side to propose full unilateral disarmament by their own government, or even to champion a ceiling or a method of arms reduction that would be regarded by colleagues or constituencies as unfavorable to continuing independence.

Nor was it part of the analysis to assume that individuals are fully conscious of the values that influence their judgment and that the thrust of unconscious factors is toward voluntary union. So far at least as the upper levels of an active elite are concerned it is implausible to suggest that continuing uncertainty will generate unconscious factors making for trust in the benevolence and good faith of alien leaders. The evidence seems to support the contrary view that protracted insecurity renders it easy to perceive the "Other" as malevolent and devious. Hence the tendency is toward the perpetuation of seeming autonomy rather than in the direction of constructing a more inclusive system of public order.

We knew that the decision process of a body politic is to be understood as a complex and relatively stable network of communication and collaboration. A system acts to sustain rather than to revolutionize its own structure. This harmonizes with the fact that more acts must be repetitive than innovative if a system is stable. More specifically, structural stability is favored by the entrapment of each individual in a limited segment of the whole. The official or unofficial role of a participant determines what is available to his focus of attention, and with whom he may communicate or collaborate. The perspectives of a participant are the result of previous experience in the position, and in the sequence of positions through which he has passed. The playing of any role modifies predispositions by rewarding an act with value indulgences or by imposing value deprivations. As a strategy of maintaining and improving their net value position, individuals continually make and unmake coalitions of an explicit or tacit character. Enough information has long been available to show a qualified observer that the private coalitions upon which members of the Soviet or U. S. elite depend for personal advancement are coalitions whose effect is to sustain rather than to supersede a divided world. Obviously the coalitions entered into by top officers in the Red Army, Navy and Air Forces are not made with Americans; and *vice versa*. Nor do the corresponding coalitions of top diplomats, civil officials, or party officials cut across the intervening zone.

There are, political scientists know, typical situations in which active elite elements have expected to benefit by means of a more perfect union. Ruling families have intermarried. Today this institutional presupposition is missing; the top men of the USSR or the USA are not dynastic heads. It is a frail reed indeed to rely upon the hope that a Moscow-Hollywood fusion of infatuated youngsters or calculating oldsters will banish the perils of nuclear fission or fusion. Some historic unifications have been the outcome of duels between appointed champions

in the manner of David and Goliath. This institutional predisposition is also missing. No one seriously expects to stake the issue of unity upon two doughty pilots armed with jets, or two teams of missile men lobbing away at one another in the South Seas. We also take note of the fact that thus far we have been unable to rely upon the appearance of an external group capable of being perceived as a common threat. The U.F.O., the unidentified flying objects, have not as yet been shown to be intelligence eyes of another planet against whom we may conceivably combine.

I have been indicating how the tools of the profession provided us with categories, propositions and cases adequate to the task of assessing the probable result of the appearance of unconventional weapons. These tools were, in fact, so used. I do not assert that all members of the profession refrained from adding to the lamentations that arose as this or that circle of humanity awoke to the poignancy of the fact that the planet is moving toward apparent doom. Limited catharsis has often been obtained by railing at the stupidity or malevolence of world elites for failing to bring the current nightmare to a peaceful end. Some among us found a measure of private satisfaction in the discovery of fresh evidence of the depravity of man and turned for consolation to the trans-empirical doctrines provided by one or another of the theological and metaphysical traditions of mankind. We need not deprecate these personal solutions so long as it is clear that they are not the distinctive roles for which our profession has sought to equip its members.

To assert that political scientists had tools that enabled us to assess a major development correctly is not to say that we are complacent about our part in the story of nuclear weapons. There is always a gap between fundamental theory and the data required to see how theoretical models explain or fail to explain specific configurations. As private scholars political scientists did not always have access to official information; and even when playing an official role a political scientist was not always shown every significant report in the possession of the government. Such limitations go beyond our responsibility as a profession. We must however assume responsibility for any limitation of theory or procedure that prevented us from making full use of every opportunity open to us.

I have been implying that it is possible to interpret our traditional body of theory as giving full recognition to the contextual character of politics. The classical literature made plain that specialized institutions of community-wide action are part of, and interact with, all institutions of the community, all personalities, all institutional and personal patterns in the surrounding world, and with the physical and biological environment. Modern logical technique has made it more apparent than

it was formerly that the intellectual task before us is not the discovery of a small number of new fundamental categories with which to designate the context of interaction. Rather, it is apparent that all comprehensive systems are formally equivalent (hence interchangeable) at corresponding levels of abstraction (and regardless of possible differences in the number of key terms employed at each level). The inference is that within a rich intellectual tradition the most significant task is to construct a continuing institutional activity by which central theory is related continuously to events as they unfold. The fundamental categories are retained as constant features of a frame of reference elaborated and employed to delineate the contours of observational fields. The relevant context is the world political process as a whole.

The limited degree of success achieved by the profession in perfecting or in encouraging the body politic to perfect such an institutional process had adverse consequences for our role in regard to nuclear weapons. Long before atomic weapons were introduced we were well aware of the importance of scientific knowledge for the technology of fighting. But we did not correctly anticipate the approximate timing of the impact of nuclear physics upon military technology. Although we were equipped to assess the political consequences of sudden and stupendous increases of fighting effectiveness we did not foresee that such an emergent was imminent. Since technical developments were not explicitly anticipated we did not clarify in advance the main policy alternatives open to decision makers in this country or elsewhere. We did not create a literature or a body of oral analysis that seriously anticipated these issues. As political scientists we should have anticipated fully both the bomb and the significant problems of policy that came with it.

I do not want to create the impression that all would have been well if we had been better political scientists, and that we must bear upon our puny shoulders the burden of culpability for the situation of the world today. We are not so grandiose as to magnify our role or our responsibility beyond all proportion. Yet I cannot refrain from acknowledging, as I look back, that we left the minds of our decision makers flagrantly unprepared to meet the crisis precipitated by the bomb. I have no desire to hold a kangaroo court on President Truman's momentous decision or upon his principal advisers; or to give credence to the insinuation that "results" had become necessary in the face of Congressional restiveness about the cost of research and development. In the light of hindsight (that should have been foresight) I want to underline the probability that the new weapon was introduced in a manner that contributed unnecessarily to world insecurity. Perhaps the critics are right who say that the bomb should have been demonstrated on an

uninhabited island before the live drops were made on Hiroshima and Nagasaki. More important is the question of how formal and effective control might have been extended beyond the decision makers of a single power. At least some members of the winning coalition might wisely have been brought into a system that operated through a common agency of inspection and direction.

Plainly there were not enough political scientists trained in physics, or sufficiently aware of the implication of impending scientific developments, to do much forward thinking and planning. This points to a failure of professional recruitment and training, and calls in question the then-prevailing conception of the political scientist's role. As a profession we are concerned with aggregate processes. It is not our job to supply the working politician with what he knows already, namely a bag of electoral and other manipulative tricks. Our distinctive perspective is not that of a trickster although we must be familiar with the trickster's outlook and his repertory if we are to assess the causes and consequences of his way of doing business for the decision process as a whole in any context. Nor is our role limited to reiterating and celebrating the ideal aspirations of the body politic, and exhibiting how value goals can be derived from fundamental postulates and principles. It is not exhausted by reporting historical sequences to be found in the rise, diffusion and restriction of myth and technique; or even by the formalization and verification of descriptive models of a scientific character. Part of our role, as the venerable metaphor has it, is scanning the horizon of the unfolding future with a view to defining in advance the probable import of what is foreseeable for the navigators of the Ship of State. It is our responsibility to flagellate our minds toward creativity, toward bringing into the stream of emerging events conceptions of future strategy that, if adopted, will increase the probability that ideal aspirations will be more approximately realized.

An implication for our future relation to science and armament is that we need to develop more political scientists who have the competence to infer the weapon implications of science and technology. It then becomes possible to anticipate the implications for collective policy.

Even a moderate degree of cross-disciplinary training or continuing contact should have enabled us to prepare for the advent of nuclear fission (and fusion). The *Review of Modern Physics* carried an article by Louis Turner of Princeton University in January 1940 in which 133 papers were appraised. They began with Fermi's original report of 1934 and came down to the Hahn-Strassman-Meitner researches which made explicit the import of Fermi's original experiment. In passing it may be noted that the contributions of a dozen nations were catalogued in

Turner's review. Not more than half a dozen of the 133 papers were by American authors. Perhaps American political scientists may be partially absolved for lack of foresight under these circumstances. But the over-all record of the profession is not thereby improved, since I do not find that colleagues in other countries were any more in touch than we were. Incidentally, it is worth recording that a standard college textbook in physics included a chapter in which the implications of current research were clearly spelled out. Ernest Pollard of Yale University referred in 1940 to the possibility of nuclear reactors that might generate electrical power or detonate as immensely destructive bombs; or that might produce radioactive substances for research and industrial processes or for a new and frightful kind of chemical warfare. I note further that at the time of the Fermi-Dunning experiment at the Columbia University cyclotron in early 1939 some science writers (especially of the *New York Times*) were quite definite about what was at stake.

Today in assessing the years ahead we need solid bases of inference about the degree to which the cost of producing unconventional weapons can be cut. Is it probable that the elites of intermediate powers will soon have at their disposal instruments capable of doing enough damage to outside powers to exert a strong deterrent effect? If so, the destiny of intermediate powers will be less grim than it has appeared to be in the recent past. If the drift toward bipolarity is reduced, there will be less hypocrisy or desperation among the elites of intermediate powers in clanging the cymbals of national loyalty in public while they readjust private family, business and political affairs in the light of the contingency that one or the other pole will dominate the globe.

It is important to estimate the likelihood that the instruments of defense can regain ground they have lost in recent times. In what period of time (if at all) is it probable that manned or unmanned flying objects can be harmlessly destroyed before they are on target? Is there any prospect that new knowledge may be used in a few years to seal off great areas of the globe behind impenetrable "energy" shells? This would open the not altogether uninviting possibility that disagreeable sectors of the globe may be sealed over and left to their own devices much as small boys put dishpans over snake pits or gopher holes.

In many ways the most disturbing result of the laggard position of political scientists in comprehending science and technology is that we have displayed no intellectual initiative in furnishing guidance to those who are in command of modern knowledge and its instrumentalities. Alert businessmen have long been on the lookout for promising applications in the marketplace. The professional military man is now accustomed to take the initiative. The question for us as political scientists

is whether we have given enough serious attention to the task of reducing the human cost of whatever violence we cannot dispense with.

As an exercise in this line of thought I invite you to use your imagination to ask what an instrument of coercion would look like that incapacitates without killing, mutilating or in any way imposing permanent incapacity. You and I will probably come up with the same answer: a gas or a drug or a beam that when applied will induce sleep or a similar state of suspension. We spent several billion dollars on A and H bombs; and it is commonly said, with some plausibility, that scientists and engineers give you what you pay for. Our suggestion (and I repeat an old proposal) is that we go down the alphabet to the P bomb, the "paralysis bomb." The technical difficulties in the way of paralyzing a city or a region are very great, given current means of delivering a concentrated gas. Possibly the instrument can be a "P beam," a paralyzing beam of sound or of some other kind capable of accomplishing the purpose.

Without being in the least committed to the specific devices referred to, I nevertheless assert that in the future we need not remain as passive as we have been in approaching the problem of harmonizing considerations of humanity with the use of whatever coercion cannot be avoided.

So far as ultra-weapons are concerned it is apparent that the polar powers have reached an impasse. If they keep on they will have the capability of destroying one another several times over. Once would seem to be enough. (Diverting resources to blasting a grave assumes that it is not a common one.) The polar powers have a common affirmative interest in preventing the rise of an outlying gangster or maniac who might take advantage of the declining cost of nuclear weapons to hold up or gravely damage them both. It may be that workable policy proposals will emerge from concentrated study. For instance, in return for universal inspection of new installations the polar powers might be willing to contribute facilities and scientists to UN laboratories situated at intermediate points and devoted to research and development of new and fundamental scientific ideas. By providing for the possible exploitation of the results under collective auspices it may be possible to expedite the development of the UN into a genuine "third factor" that concurrently expresses an inclusive interest. Senator Anderson of the Joint Committee on Atomic Energy has already declared in favor of any policy that holds promise of joint activities that "obsolesce" old weapons around which vested and sentimental interests are crystallized.)

Since we are aware of the unforeseeable timing of the many factors that may affect a resort to arms it is evident that rational policies on behalf of peaceful cooperation do not rely upon a single avenue of approach. Wise strategy appeals to as many potential pockets of motiva-

tion as possible by making continual use of tactical ingenuity in applying every instrument of policy (diplomatic, military, economic, ideological).

It is generally believed that peaceful cooperation can be most readily encouraged in the field of economic growth. And there are grounds for predicting that developments that impend in the technology of production will rival the leaps that have recently occurred in weapon technology. This brings me to the consideration of our relationship as political scientists to these potentialities. Although the devices that contribute to production may also be employed for destructive purposes, my present concern is with the affirmative uses of science.

II. POLITICAL SCIENCE AND PRODUCTION

Impending is control of weather and climate. As our knowledge of the upper atmosphere increases it will be obvious that the seeding of local cloud formations is a relatively trivial precursor of hemispheric global control. Impending is the solution of the problem of obtaining pure water at low cost from the sea for irrigation purposes. Taken in conjunction with newly available energy sources it is not too early to anticipate the reclamation of the wastelands of the earth—the deserts, the polar ice caps, the tropical rain forests, the mountains (levelled to productive plateaus). As J. G. Harrar has told us, the total solar energy that reaches the earth every 48 hours is approximately equal to all the known reserves of coal, petroleum and wood. Clearly the conversion of relatively minute amounts to usable form would meet the energy needs of future generations. Already enough progress has been made to indicate that in the immediate future many local power needs can be supplied more economically by solar energy than by nuclear installations.

As political scientists we are conscious of the implications if great resource changes are introduced into a divided world. Imagine that the arid areas inside the Soviet zone are populated with the density of the fertile districts. Suppose further that the non-Soviet world does away with the arid lands of the United States, Mexico and South America, the Sahara, and the Middle East. If these regions become as populous as the more habitable parts of the countries where they are located the population of the non-Soviet world will be increased relatively more than the Soviet area.

Think next of the tropical forests. If the tropical rain forests of Central and Northern South America, of Mid-Africa, of India and of South-eastern Asia are made fit for human life to the same degree as the more temperate regions near them the relative population of the non-Soviet world will appreciably increase.

If mountainous areas are transformed into plateaus, and the plateaus

are populated to the density of neighboring areas, the population of the non-Soviet world will also sustain a relative rise.

We know that the political consequences of changes in population and energy production depend upon the impact of these developments upon the "threat value" or the "asset value" of the members of the world community to one another. We expect that the flow of capital and know-how required to modernize production tends to conform the facts of economic growth to the configurations that predominate in the arena of world politics. One alternative of policy is to mitigate or modify this tendency to pour the concrete of capital investment into the mould of a current power alignment. To what extent can this result be achieved by instituting multilateral control of great programs of reclamation in selected districts? Can the Sahara, for instance, be jointly developed? Since the ruling circles of a split world pursue different objectives in terms of social structure and ideology it is only feasible to think of even restricted programs of multilateral cooperation within the frame of an agreement in which are prescribed the permissible proportions between governmentalized and non-governmentalized operation to be preserved at successive stages of the project. Further, it will be essential to determine whether the program is intended to consolidate an existing national unity or to lay the foundation for a new nation (one drawn, for example, from widely varying ethnic sources; or from a single principal source of people and culture).

The factor of geographical dispersion has an important bearing upon our expectations. The sources of solar and atomic energy are more capable of being widely distributed than the sources exploited by a technology of fossil fuels like petroleum and coal. It is axiomatic that a decentralized pattern of access to energy provides a favorable resource base for a decentralized outlook, and that the perspectives comprising such an outlook sustain a decentralized network of policy formation and execution. If a reversal is to occur in the trend toward bipolarizing the world, and a pattern resembling the Great Power System of the last century is to revive, two conditions at least must be fulfilled: a network of strong, coordinate centers of energy production; and cheaper costs of producing the newer weapons.

I have been talking of the resources found in the wastelands or neglected opportunities on the surface of the continental blocs. We must take the fact into account that new resources are in prospect whether we look beneath or above the land surface of the earth. To begin with the seas: we shall learn to mine the waters for minerals and to farm the oceans for foodstuffs on a scale hitherto unthinkable. In regard to resources above the surface: we are close to the first experimental expedi-

tions to the moon; and, presently the planets. In this setting the traditional questions that center around the control of air space take on new significance.

As specialists in public law it is not difficult for us to anticipate the form in which conflicting claims to these new resources are likely to be phrased. In connection with the seas those who push particular claims to the exclusive exploitation of a given region will talk in terms of "the territorial sea," "contiguous zones," "jurisdiction" and the "continental shelf." Nation states whose officials push particular claims to share in exploiting the resources of an area will invoke the "freedom of the seas" and other internationalizing concepts. The probing of the upper atmosphere, satellite launching, space platforms and the like will pose the problem of how to adjust claims to exclusive control of "air space" against claims to share control. As expeditions to the moon or the planets become more imminent the question of "who owns what" or "who controls what" will bring into the debate the authoritative language traditionally employed in connection with the acquisition of territory ("exploration," "occupation," "conquest" and other concepts emphasizing priority in time and effectiveness of control).

As clarifiers of the goals and alternatives implicit in a decision process and as advisers of the participants we have an opportunity to reduce the amount of unnecessary friction by establishing a frame of reference in advance of the facts. When factual details appear they will of course exhibit some novel elements; common goals and principles will not. The members of the world community have a long history of accommodating "exclusive" claims and "sharing" claims with one another (as new resources provide new base values for the participants in the world arena).

It is, of course, essential that in taking advantage of this opportunity we deal with the entire context of value goals and principles as they relate to potential facts. I have referred to sets of doctrines that in all probability will be invoked when claims are made. The chief function of these formulations is to guide the attention of decision makers to the context in which pertinent activities occur. Formulas assist in recognizing and evaluating the consequences for international public order of accepting the exclusive or the sharing claim in particular cases or categories of cases.

When we examine past trends in world history it is not difficult to recognize that shifts have occurred in the relative emphasis laid upon exclusive or sharing claims. Grotius was speaking for the Netherlands and for other challengers of the claims of Spain, Portugal and England to monopolize great stretches of the seas. Sweeping readjustments were

made in doctrine and in its applications relating to the seas. At first they were mainly in the direction of consolidating an international order in which sharing claims were widely accepted ("freedom of the seas"). In recent decades the trend has been the other way. As my colleague Myres S. McDougal has shown in some detail, claims to the exclusive enjoyment of resources have been accepted as "reasonable" in the light of facts that have appeared in the course of applying science and technology. A recent tabulation shows that no more than thirteen states accept the ancient three-mile rule for the territorial sea. Forty-five states repudiate it in varying degree, claiming wider limits. Contiguous zones of many kinds have been accepted for the administration of customs, the security of neutral states against belligerent activities, fishing conservation, appropriation of the resources of the sea-bed and of the continental shelf.

When we think configuratively about the problems raised in reference to the new resources it is clear that instead of relying on blanket principles (like "freedom of the seas" or "freedom of the air") the most fruitful policy alternatives are likely to emerge when we anticipate the appearance of characteristic factual contexts, and consider how the values chiefly at stake in them can be maximized. Hence we would not expect to apply the same prescription (1) to the sharing of air space for weather observation (where equipment is used that is expressly designed for the purpose and perhaps registered, and when the information obtained is made public) and (2) to the sharing of air space for projects of weather or climate control that may be deleterious to local values.

The contextual (or, synonymously, the configurative) approach is a challenge to imagine the full range of possible means of anticipating and resolving difficulties. On the most uncertain matters it is appropriate to call attention to the need of exploring the possibilities of agreement in advance of conflict. The inference is that no time should be lost, for instance, in putting into the hands of the UN the facilities for research, development and operation of satellites, "space platforms" and travel beyond the limits of the earth's atmospheric and gravitational fields. Doubtless the USA and the USSR will continue to compete with independent programs. Since the polar powers have a stake in moderating the conflict in which they are engaged in the hope of eventual harmony through agreement, not catastrophe, a practical method would appear to be to strengthen the "third factor," especially when both powers are also included within it.

The rapid introduction of new resources under present conditions calls for some degree of community and regional planning; and planning poses thorny questions about the structure and ideology of society. To an in-

creasing extent questions of this kind need to be answered directly rather than by default. It must be conceded that American political scientists are not especially well equipped to participate in the planning function on the scale required. Although we are accustomed to corroborate the classical authorities and the Founding Fathers in praise of the middle classes as contributory to popular institutions of government, we have not as a rule dealt with these traditional doctrines in significant ways. For instance, we have not explored the principles of proportion that are most likely to consolidate or to sustain at various stages of industrial growth the perspectives and operational technique of popular government. Shall we, for example, rely upon a 30-40-50 rule to guide public policy in regard to the permissible degree of market control permitted to private interests? (For example: When one interest has 30% control of output, shall it be subject to special regulations designed to nullify the side-effects of power that go along with economic control? When one interest rises to 40% shall we put governmentally appointed trustees on the Board of Directors? At 50% shall government trustees predominate?)

Whatever the workable rules of proportion may be in representative contexts it is evident that we need to guide our studies of trend correlation and of comparative cases in order to improve the available bases of inference in such matters.

The same approach—the search for rules of proportion—applies to every institutional and personality pattern in a body politic. What are the optimum proportions of community resources to devote to elementary, intermediate, advanced and ultra-advanced education? To research and development in science and technology? To positive and negative sanctions for correctional and other purposes?

One way to jar “cakes of custom” out of the mind is to draft specifications for the first Mayflower expedition to establish continuing occupation outside the earth. (Possibly it could be “Noah’s Jet”?) What proportion of men, women and children of which culture or combination of earth cultures shall we select? What ideological traditions, secular and sacred? What class backgrounds (elite, mid-elite, mass)? What individual and group interests? What personality structures?

By asking questions of this kind we are in a position to assess our present stock of knowledge concerning the interdependence of institutions specialized to power, and all other institutions in the social process of any community, together with the forms of personality involved. These, of course, are the recurring issues of political science and historical interpretation as well as policy.

III. POLITICAL SCIENCE AND EVOLUTION

I have been referring to a few implications of science and technology for weapons and production, and sketching some political ramifications. As political scientists we are perhaps even less well prepared to anticipate developments in genetics, experimental embryology and related disciplines. Taken together these fields signify that, as Julian Huxley has often put it, man is on the threshold of taking evolution into his own hands. By influencing the genes that constitute the key units in man's biological inheritance we affect the entire potential of future generations.

Important as recent innovations are in radioactivity I do not want to give more than passing notice to the dangers that they embody. The only feasible means of coping with these factors is by policies that avert war and preparation for war, and install proper precautions in the handling of high energy radiation for other purposes.

Quite recently the dangers that arise from radioactivity have been authoritatively brought to public notice: all high energy radiation that reaches the gonads stimulates gene mutations; more than 99 per cent of all mutations are dangerous; genes can only be eliminated by the death of the gene carrier or by his incapacity to reproduce. Nearly two years ago H. J. Müller told us that the bomb tests since the war had already exposed the inhabitants of the earth to radioactivity comparable with that of the inhabitants of Hiroshima and Nagasaki after the original explosions. He estimated that about 80,000 harmful mutations are involved and that "it will mean, in the end, several times this number of hampered lives."

It has been pointed out that perhaps the most satisfactory index of genetic damage is the sum of tangible defects existing among living individuals. We are speaking of such stigmata as "mental defects, epilepsy, congenital malformations, neuromuscular defects, hematological and endocrine defects, defects in vision or hearing, cutaneous and skeletal defects, or defects in the gastrointestinal or genitourinary tracts." We are informed that about 2 per cent of the live births in the United States have defects that are of "simple genetic origin and appear prior to sexual maturity." If mankind were subjected to a "double dosing" of radiation the present level of genetic defects would rise, and would eventually be doubled.

Regulatory measures are obviously needed against wars and weapon tests; and they are essential to the disposition of nuclear waste from industrial plants. (It has been remarked that a nuclear power plant is to be viewed as a large scale production of both highly poisonous gas and explosives under a single roof.)

The principal questions to which I desire to call attention pose issues of a relatively new and different order. Some of these questions have

already come up in controversies over artificial insemination. They have embarrassed the champions of the orthodox prescriptions that prevail in several fields (theology, ethics, jurisprudence). Shall we call a child legitimate whose biological father is not identical with the sociological father? Even with the consent of the latter? With spermatozoa from a known or unknown source? (A possible international question is whether a nation state like the United States can claim the child as a citizen if the spermatozoa employed originated with an American mail order house and was sent by air mail for use abroad.)

Poignant as these issues are in specific cases they do not confront us with the consequences for public order that are to be anticipated if the progress of biology separates insemination and child bearing from genital contact. The assumption is often made that the continuation of sexual rectitude and even civic order depends upon charging every genital contact with the blessings and perils of procreation. The impending improvement of oral contraceptives, joined with other recent advances, are factors that already suggest the wisdom of other norms and sanctions of public order.

Other developments are threatening current ratios of the influence and power of the sexes. Given the millions and millions of spermatozoa produced by one male and the technique of canning by refrigeration, any very large number of males becomes relatively redundant for purposes of procreation. Must the male rest his future upon other values such as the strictly aesthetic appeal of the male contour? Before the female of the species becomes too complacent in this context it may be worth recalling the significance of some current experiments for the removal of the primordial female function from the body and into other receptacles. (Women, too, may have to rely upon their charm, a role for which their experience has provided extensive preparation.)

Apparently we are closer than most of us like to think to the production of species that occupy an intermediate position between man and the lower animals (or even plants). It is sometimes said, even in august quarters, that "one has not yet succeeded in making a species from another species." Theodosius Dobzhansky notes, however, that "the feat of obtaining a new species was accomplished more than a quarter of a century ago." In recent decades a fair number of new species have been brought into being. It is also true that some species that exist in nature have been recreated experimentally. A garrison police regime fully cognizant of science and technology can, in all probability, eventually aspire to biologize the class and caste system by selective breeding and training. Such beings can, in effect, be sown and harvested for specialized garrison police services or for other chosen operations.

Great strides have been taken in brain design. Experimental models of

robots have been built who solve problems of a rather complex order in a given environment. Some of these machines look after themselves to a degree, obtaining and using the raw materials required for energy and repairs. Already it is claimed that the function of reproducing its kind, and of interacting with others, can be in-built.

The question then rises: Given our concern for human dignity when do we wisely extend all or part of the Universal Declaration of Human Rights to these forms? When do we accept the humanoids—the species intermediate between lower species and man, and which may resemble us in physique as well as in the possession of an approximately equivalent central nervous and cortical system—as at least partial participants in the body politic? And at what point do we accept the incorporation of relatively self-perpetuating and mutually influencing “super-machines” or “ex-robots” as beings entitled to the policies expressed in the Universal Declaration?

It is obvious that we are not too well equipped by cultural tradition to cope with these problems. A trait of our civilization is the intense sentimentalization of superficial differences in the visible format of the groupings to be found even within the human species. Recall the theologians, ethicists and jurists who have devoted themselves to the elaboration of symbols to show that the white race alone is genuinely human and hence solely entitled to the dignity of freedom. Recall, too, the counter-assertions, nourished in the soil of humiliation, that have arisen among ethnic groups that seek to overcome their contempt for themselves by dragging down the pretensions of the white imperialist.

Let us recognize that the traditions of certain non-Western civilizations are in some ways better adapted to the problem than the Graeco-Roman and Judeo-Christian perspectives. They possess a relatively broad basis for identifying the primary ego of the individual with a self that includes more than strictly human species in the congregation of living forms. A world view that includes the possibility of reincarnation in lower animal shapes, for example, may prepare its devotees to empathize more readily with other than strictly human species and varieties. Even they, however, may have their troubles with a mobile power plant in nearly human form.

The most disturbing question, perhaps, arises when we reflect upon the possibility that super-gifted men, or even new species possessing superior talent, will emerge as a result of research and development by geneticists, embryologists or machine makers. In principle, it is not too difficult to imagine a superior form. For instance, our sensory equipment does not enable us to take note of dangerous radiation levels in the environment. We have no inborn chattering of a Geiger counter.

I spoke before of taking the intellectual initiative for the use of science

and technology for the fuller realization of our value goals. It is plain that if we bring certain kinds of living forms into the world we may be introducing a biological elite capable of treating us in the manner in which imperial powers have so often treated the weak. A question is whether the cultivation of superior qualities ought to be limited to intellectual capability. The answer, I feel confident you will agree, is in the negative. We need to be sufficiently vigilant to prevent the turning loose on the world of a hyper-intelligent species driven by an instinctual system especially inclined toward predation. The blood-stained story of our own species is only too familiar (the stories about succulent missionaries whose bodies were more readily incorporated than their messages are not wholly without foundation). Can we improve the prospects of developing a form of intelligent life copied not after our own image, but after the image of our nobler aspirations?

It is not to be overlooked that the problem of human capability can become acute if in the years ahead we escape from our present habitat on the earth, or are visited by other forms of intelligent life. There are, after all, untold millions of environments resembling our solar system, and it would be more remarkable to find that but one planet is inhabited by a complex living form than to encounter parallel developments. It would of course be embarrassing, at least, to discover that we are the savages or that we are put together on a markedly inferior biological plan.

IV. OUR FUTURE PROGRAM

The fact is that many of the problems to which I have been referring will be upon us long before we can make great changes in the ideological outlook or the socio-political patterns of life in this country or elsewhere. The same point applies to ourselves in our role as individuals and as members of the political science profession. Considering our present predispositions how can we improve the likelihood of contributing to the decision process at every level, from the neighborhood to the world as a whole?

It is abundantly clear that the impact of science and technology does not occur in a social vacuum, but in a context of human identifications, demands and expectations. I make the modest proposal that it is appropriate for political scientists, in company with other scientists and scholars dealing with human affairs, to improve our procedures of continuous deliberation upon the potential impacts of science and technology upon human affairs. No doubt the American Political Science Association and other professional societies constitute an appropriate network for the purpose. We can sustain continuing conferences devoted to the examination of emerging developments. As fellow professionals

we have special responsibility for giving thought to the aggregate effects of any specific innovation.

Our first professional contribution, it appears, is to project a comprehensive image of the future for the purpose of indicating how our overriding goal values are likely to be affected if current policies continue.

A closely related contribution consists in clarifying the fundamental goal values of the body politic. We are accustomed to confront political ideologies with new factual contingencies and to suggest appropriate specific interpretations. We also confront political doctrines with rival doctrines, and with comprehensive theological and metaphysical systems. I have called attention to the point that the basic value systems of European civilization, in particular, are likely to be exposed to sweeping challenge as biology and engineering narrow the obvious differences between man and neighboring species, and between man and centrally operating machines. The crisis will be peculiarly sharp if we create or discover forms of life superior to man in intellect or instinctual predispositions. Our traditions have not been life-centered, but man-centered. We possess various paranoid-like traditions of being "chosen." Clearly a difficult task of modifying these egocentric perspectives lies ahead.

The third task is historical and scientific. It is historical in the sense that by mobilizing knowledge about the past we are enabled to recognize the appearance of new patterns and the diffusion or restriction of the old. It is scientific in the sense that we summarize the past in order to confirm (or disconfirm) propositions about the interplay of predisposition and environment. If we are to serve the aims of historic recognition and of scientific analysis, one of our professional responsibilities is to expedite the development of more perfect institutions specialized to continual self-observation on a global scale. Self-observation requires guidance by a system of theoretical models of the political process in which a continuing gradation is maintained between the most inclusive model and submodels adjusted to more limited contexts in time and space. Continual self-observation renders it necessary at each step through time to reevaluate the appropriateness of the operational indices for the variables and concepts employed at the most recent step. In this way all the concepts that figure in systematic, descriptive political science can be kept chronically pertinent to the ordering of political events as the future unfolds.

The fourth task is inventive and evaluative. It consists in originating policy alternatives by means of which goal values can be maximized. In estimating the likely occurrence of an event (or event category), it is essential to take into account the historical trends and the scientifically ascertained predispositions in the world arena or any pertinent part thereof.

The relationship of American political science to these tasks is in many ways unique. The typical department is a microcosm of the macrocosm of university faculties of the social sciences and humanities, and the school of law. It is no secret that a syndicate of philosophers, historians, behavioral scientists and public lawyers is capable of producing some degree of tension among themselves, especially when budgets are at stake. This has led to the suggestion that every component skill should be sent back where it came from—to the departments of philosophy, history, sociology and psychology, for example, and to the law school. In this way political science could be given back to the Indians. The catch is that we are not agreed who the Indians may be.

The present situation does make it possible for political scientists to take the lead in integrating rather than dividing our intellectual community. Compared with an entire university, which has become a non-communicating aggregate of experts, each department of political science can be a true center of integration where normative and descriptive frames of reference are simultaneously and continuously applied to the consideration of the policy issues confronting the body politic as a whole over the near, middle and distant ranges of time.

The profession is advantageously situated therefore to take the lead in a configurative approach to the decision process in society. Where it plays this part, political science is the policy science, *par excellence*. If the implications of science and technology are to be correctly appraised, it will be essential to recruit some trained personnel from such fields into political science, to improve the science-content of professional education, and to provide for continuing cooperation among the professions involved.

It is quite unnecessary for any one individual to emulate the universal ambitions of renaissance man. But if we are to take the lead in performing the configurative or matrix function it is quite essential for the profession as a whole to achieve the division of labor, the understanding and the insight capable of realizing as fully as possible the dream of relevant universality. Each of us can at least widen the boundaries of the self and open the way to identify with living forms that differ from traditional images. We can step toward the possible reconciliation of a growing mastery over Nature with the dignity of freedom for all that lives. In the congregation of living forms human life may come to play a yet more distinguished role in generations to come, a role that transcends even the vision of the commonwealth of man championed by the distinguished political scientist and statesman, the centennial of whose birth we take pride in according special commemoration this year.